

We Claim:

- 1           1.     A bistable structure comprising:  
2               a deflection element including mechanically constrained end points and a compliant  
3 span between the end points that is substantially free to deflect between two stable positions  
4 when a force is applied at a point along the span;  
5               wherein the deflection element span is provided, as-fabricated, curved in one of the  
6 two stable positions and in a mechanically unstressed condition along span length;  
7               wherein the as-fabricated curve of the deflection element span includes a curve  
8 maxima at a point along span length that is at least about  $\frac{1}{4}$  of the span length from the end  
9 points of the span; and  
10              wherein the deflection element span is constrained to substantially prohibit  
11 development of a second bending mode that is characteristic for the span as the element  
12 deflects between the two stable positions.
- 1           2.     The bistable structure of claim 1 wherein the deflection element comprises a  
2 beam.
- 1           3.     The bistable structure of claim 1 wherein the deflection element comprises  
2 two beams connected together at a point along the spans of the beams by an interconnecting  
3 clamp that prohibits development of a second bending mode that is characteristic for the  
4 spans as the element deflects between the two stable positions.
- 1           4.     The bistable structure of claim 1 wherein the deflection element comprises a  
2 plate.
- 1           5.     The bistable structure of claim 1 wherein the deflection element comprises a  
2 diaphragm.

1           6.     The bistable structure of claim 1 wherein the constrained end points of the  
2 span are clamped.

1           7.     The bistable structure of claim 1 wherein the constrained end points of the  
2 span are hinged.

1           8.     The bistable structure of claim 1 wherein the constrained end points of the  
2 span comprises torsional spring elements.

1           9.     The bistable structure of claim 1 wherein the span comprises aluminum.

1           10.    The bistable structure of claim 1 wherein the span comprises silicon.

1           11.    The bistable structure of claim 9 wherein the curve of the deflection element  
2 span corresponds to a lithographic mask defining the curve as-fabricated.

1           12.    The bistable structure of claim 11 wherein the lithographic mask defines an  
2 etch mask pattern for etching the curve of the deflection element span.

1           13.    The bistable structure of claim 1 wherein the curve of the deflection element  
2 span comprises a trajectory along the span length corresponding to a first bending mode  
3 characteristic for the span.

1           14.    The bistable structure of claim 1 wherein the curve of the deflection element  
2 span comprises a trajectory along the span length defined as  $\frac{\bar{d}(1 - \cos(2\pi x/l))}{2}$ , where  $\bar{d}$  is  
3 the curve maxima value and  $x$  is the distance along the span length between 0 and  $l$ .

1           15.    The bistable structure of claim 1 wherein the maxima of the curve of the  
2 deflection element span is located at substantially the center of the span.

1           16.    The bistable structure of claim 1 further comprising a plurality of electrically  
2 conductive relay contacts disposed at positions that are separated from the deflection element  
3 by a separation distance selected such that an electrical connection is provided between the  
4 relay contacts when the deflection element is in one of the two stable positions.

1           17.    The bistable structure of claim 16 wherein the electrical connection provided  
2 between the relay contacts comprises mechanical contact of each relay contact with an  
3 electrically conducting cross bar that is compliantly connected to the deflection element.

1           18.    The bistable structure of claim 1 further comprising a force generation  
2 actuator including a mechanical force applicator that is disposed relative to the deflection  
3 element to apply a force to the deflection element span and that is connected to receive an  
4 electrical stimulus for applying the force.

1           19.    The bistable structure of claim 18 wherein the electrical stimulus comprises an  
2 electrostatic actuation voltage.

1           20.    The bistable structure of claim 18 wherein the electrical stimulus comprises a  
2 thermal actuation voltage.